

DEAFNESS IN THE SCHOOL CHILD

A Lecture

*Delivered to the Teachers of the Glasgow School Board
in the Glasgow High School on 18th February, 1909*

BY

JAMES KERR LOVE, M.D.

AURAL SURGEON, GLASGOW ROYAL INFIRMARY
AURIST, GLASGOW INSTITUTION FOR THE DEAF AND DUMB

*The first part of the Lecture is a reprint from the
Glasgow Medical Journal (February, April, 1909);
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CEREBRAL PHYSIOLOGY AND THE EDUCATION OF ABNORMAL CHILDREN.

By JAMES KERR LOVE, M.D.

It is part of the working theory of every physician and surgeon that in all but the very young—all, say, who are older than 6 months—the surface of the brain has by education become functionally differentiated into specialised centres, which govern the outlying parts of the body, whether these be sensory, such as the eye and ear, or motor, such as the muscles of the limbs.

At first the movements in a very young child are reflex merely; they are not governed by any experience, and they are not directed by anything which we recognise as will.

Education, which begins as soon as the child is born, sets apart certain areas of the surface—hence called cortical centres—to preside over the exercise of special functions.

But whilst education is necessary for the development of this presiding power in the surface of the brain, it has to proceed within rigidly fixed lines, governed by heredity and anatomical connection, and hence we always find the same small area of the brain presiding over the same set of functions. We do not find in one case an area of the surface controlling the movements of the arm, and in another case the corresponding area governing the sense of sight, or the movements of the leg.

Now, the two great sciences which have developed our knowledge of cerebral localisation are experimental physiology and clinical pathology. By experiments on animals it is possible to map out those portions of the surface of the brain

which have become specialised for the government of individual sensory and motor functions; and by comparing the symptoms of disease during life with the evidences of disease found after death, a set of conclusions is arrived at which tallies pretty exactly with the results of experimental physiology.

The accompanying map of the surface of the brain shows approximately the principal centres or specialised areas (Fig. 1).

(At one time these cortical centres were regarded as accurately mapped areas, separated by almost linear margins. More recent research points to them rather as areas within which the special sense indicated is most active; and in normal children with the usual stimuli operating through the usual

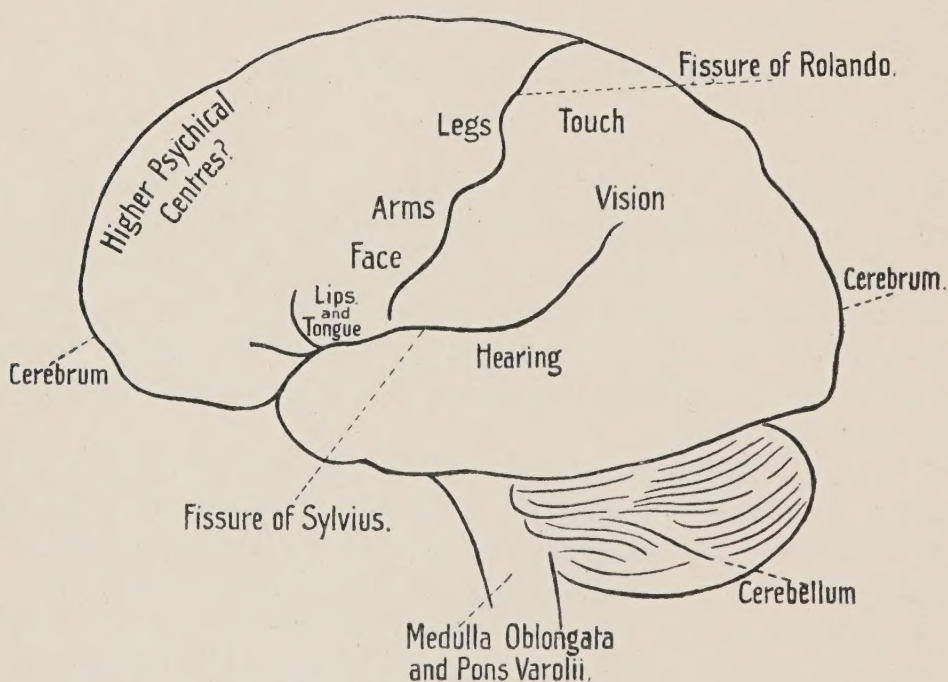


FIG. 1.

Map of the surface of the brain, showing approximately the various centres or specialised areas.

channels—the eye, the ear, the organs of taste, touch, and smell—the differentiation of the cortex is so uniform that almost no variation in the areas occurs. What may occur in abnormal children will be noticed later.)

The cortical centres of the brain not only receive impressions from without, but store away past impressions, and thus become memory centres. Whether this takes place within the special centre itself or in some associated part of the brain does not matter for the purpose of the present argument.

It will be found convenient for the purposes of this paper to divide the language centres shown in Fig 2 into *language appreciating centres* (the auditory, the visual, and the touch centres), and the *language producing centres* (the speech centre, and the group used in writing, in spelling the manual alphabet, and in producing gestures and signs—WMG in the figure). The latter are usually regarded as motor centres (Ferrier and others). Sometimes they, like the language appreciating centres, are regarded as true sensory centres, like those for hearing, sight, and touch (Bastian and others), with associated motor centres in the medulla and spinal cord lower down. So long, however, as the double function of receiving and storing impressions is associated with each, the difference above indicated may be neglected so far as the arguments here used are concerned.

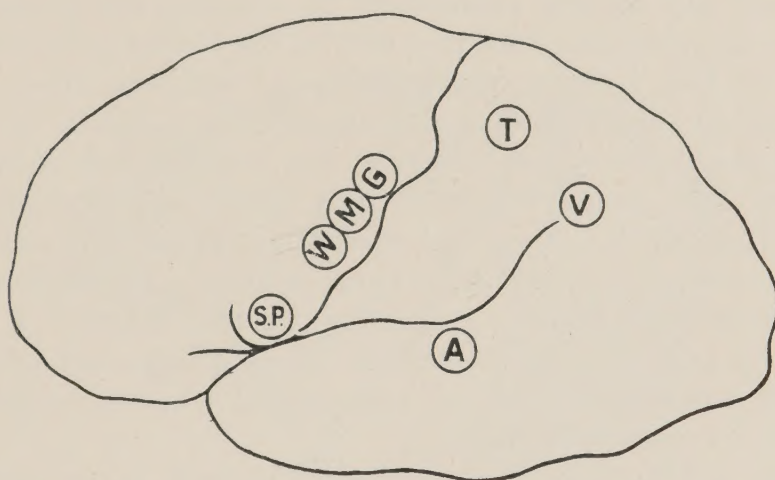


FIG. 2.

Centres concerned in the appreciation and production of language. A, auditory centre; Sp., speech centre; V, visual centre; WMG., writing, manual alphabet, and gesture language centres; T, touch centre. (The group WMG represent Bastian's cheiro-kinæsthetic centre; Sp., the glosso-kinæsthetic centre.)

In studying cerebral localisation in connection with education, it is important to consider the history of the probable rise of these centres in the development of the race, and then the known order of their rise in the development of the individual. Lastly, when one or more of these centres is destroyed, we shall see what alterations are made in the cerebral arrangements.

In animals the brain arrangements are much simpler than in man.

It is true that in some animals special parts of the brain

are more highly developed than in man—for instance, that which governs the sense of smell in dogs. But the cerebral hemispheres are always smaller and less convoluted than in man; and, as we ascend in the scale, the higher animals show arrangements which closely resemble those of man. Thus, in the monkey the convolutions are more numerous, the cerebral hemispheres greater in bulk than in the rabbit or the pigeon. They still fall greatly short of those in man, though the great fissures and divisions of the surface of the brain clearly foreshadow what is to come in the human species. And it may be put down as a general principle that the amount of intelligence displayed by an animal is in direct proportion to the size which the cerebral hemispheres bear to the rest of the brain (Figs. 1 and 3).

The young child is born with all the potentialities of the adult brain. Every convolution and groove is present at birth, and only awaits education to develop the power latent in each. In studying the rise of the specialised centres in the history of the human race, we may exclude from present consideration those which are possessed in common by animals and man, such as sight, hearing, the centres for moving the arms and legs, those for taste and smell, and the centre for touch. Having done so, we find that, from the educational point of view, the chief difference between animals and man is the power of speech possessed by the latter. I am not denying to animals the possession of language, but speech and its recently acquired form of expression, written language, are possessed by none but man.

In the normal child the acquisition of language is the acquisition of speech. A purely sign stage is a very temporary one, and before he learns writing the child's vocabulary is complete for all the ordinary purposes of life. He learns speech by imitation. He produces more or less accurately the sounds which he has heard others produce, and these he modifies by movements of the lips and tongue similar to those he has seen others perform. After many attempts he speaks so that others understand what he means.

But sound or phonation is no essential part of speech. In whispered speech phonation is absent. Neither is a passing of a current of air through the larynx, as occurs in whispered speech, any necessary part of speech, for we may lip-read the speech of a person through whose air-passages no current is passing. Speech in the strictest sense is the action of the muscles of the tongue and lips for the production of understood symbols, and under the control of a special motor centre

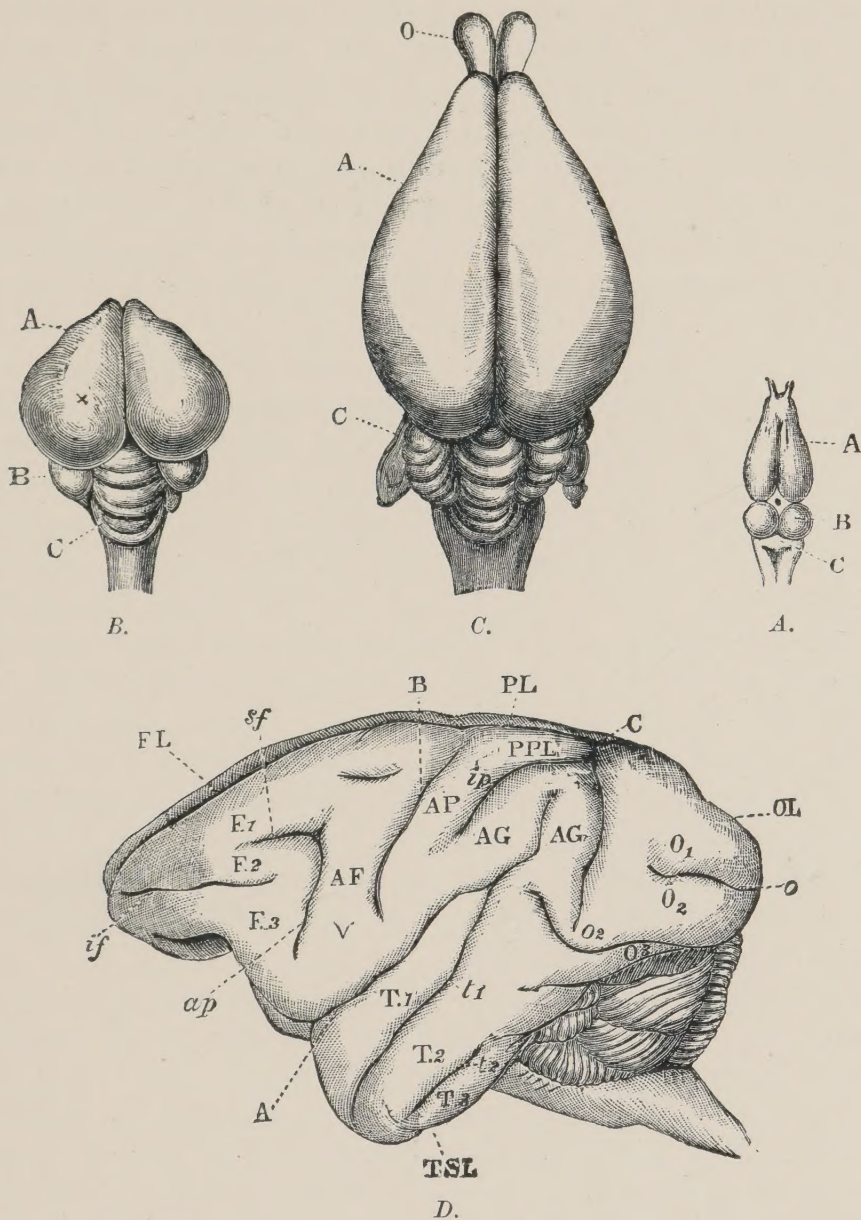


FIG. 3 (from Ferrier).

- A.—Brain of frog. A, cerebral hemispheres; B, optic lobes; C, cerebellum.
 B.—Brain of the pigeon. A, cerebral hemispheres; B, optic lobes; C, cerebellum.
 C.—Brain of the rabbit. A, the smooth cerebral hemispheres; O, the olfactory bulbs; C, the cerebellum.
 D.—Left hemisphere of the brain of the monkey (Macaque). A, the fissure of Sylvius; B, the fissure of Rolando; C, the parieto-occipital fissure; FL, the frontal lobe; PL, the parietal lobe; OL, the occipital lobe; TSL, the temporo-sphenoidal lobe; F1, the superior frontal convolution; F2, the middle frontal convolution; F3, the inferior frontal convolution; sf, the supero-frontal sulcus; if, the infero-frontal sulcus; ap, the antero-parietal sulcus; AF, the ascending frontal convolution; AP, the ascending parietal convolution; PPL, the postero-parietal lobule; AG, the angular gyrus; ip, the intra-parietal sulcus; T1, T2, T3, the superior, middle, and inferior temporo-sphenoidal convolutions; t1, t2, the superior and inferior temporo-sphenoidal sulci; O1, O2, and O3, the superior, middle, and inferior occipital convolutions. O1, O2, the first and second occipital fissures.

in the brain. It may be quite silent, and yet remain true speech.

It is important to dissociate the phonetic from the kinetic element in speech, because they are registered in separate centres of the speaker's brain. A person may become so deaf that he cannot hear the sound of his own voice, and yet speak quite distinctly; while in a case of motor aphasia the hearing of the the patient's own voice is perfect, but the production of the movements which result in speech is impossible. The normal child, however, corrects the tone and pitch of his voice by using his ear, whilst both his eye and his ear are at work in helping him to produce vowels and consonants, and the result is distinct, well-intoned musical speech. In imitating the movements which he finds result in speech, he is also guided largely by his sense of touch, so that the movements of his lips and of his tongue enable him to reproduce accurate speech, even when the latter is not phonetic. The impressions which have reached the child through the two great gateways of knowledge—the eye and the ear—have enabled him to respond with speech, for which there is no substitute in the very young child; and when he arrives at school age he meets his teacher with a vocabulary which, although not extensive, has been so long used for the expression of his thought that its use has become automatic. The pre-speech or sign stage of the hearing child's life is short and its effects transient, and does not influence profoundly his ultimate thought methods.

In discussing the operation of the language centres, it is important to distinguish between speech and language. Language, as we shall see, includes speech and very much more; speech is the expression of thought by articulate movements. For want of the observation of this distinction, physiological and clinical text-books often suffer in clearness—e.g., the translation of Professor Preyer's book, *The Infant Mind*, also Hutchison and Rainy's *Clinical Methods*, where speech proper is referred to as "spoken speech" and writing as "written speech."

There is a sense in which the history of the individual is the history of the race, and the history of the race is the history of all the life which has preceded it, and this must be borne in mind in tracing the rise of intelligence in the young child. Starting with the assumption that language is the common possession of animals and man, let us see in what this common possession consists. And in order to make this and much more which follows clear, we must define what language is.

Language is that by which thought or feeling is expressed

or conveyed. It is not the exclusive property of man. In both its vocal and silent forms it exists amongst animals, and serves for the thorough education of the young by the mother just as it does with us. When language becomes not only vocal but articulate it is commonly called speech, and as such is the exclusive property of man. As used by man, language is either natural or artificial.

Natural language consists chiefly of facial expression, as shown in crying, frowning, laughing, &c., most elements of which are possessed alike by animals and man, and most elements of which are retained by man to ornament or enforce the more exact and extended form of language which we call speech. These facial expressions, together with gesticulation and gestures imitating actions, form the sign-language of the deaf, a language which is really cosmopolitan, and is understood, even when somewhat abridged, by the deaf of all countries. This sign-language of the deaf has nothing to do with the manual alphabet language, which is not a natural but a purely conventional form of language, and is really a system of writing in the air by means of the hands.

There can be little doubt that these natural signs were the earliest form of human language, and there is no doubt at all that they are the earliest form of language understood by the young child. From his earliest infancy the child has conventional words associated with these signs, but the signs are understood long before the words, and without the use of the signs the education of the child would be indefinitely postponed. The mother who invited the child to leave his nurse's arms without smiling and holding out her own arms would hopelessly fail to make the child understand the words, "Come to me, my dear." And there is no doubt that the ease with which deaf children fall back on natural signs as a means of expressing their thoughts and feelings is partly due to the fact that these are the oldest forms of language used by man. The outfit for the practice of this natural sign-language consists of fair eyesight and the use of the muscles of the face and upper limbs, or, in the map of the surface of the brain, the integrity of the centres V and G, together with their associating fibres (Fig. 2). In the young child speech follows the language of signs and gestures, and precedes drawing and writing, and in the history of man there can be no doubt that speech also was added to the sign-language long before writing or graphic delineation of any kind came into being.

We know nothing of the first forms of human speech, but these must be of great antiquity; so great, indeed, that all

present forms of speech are, in comparison, recent, and all forms of writing as of yesterday. Primitive human speech was probably developed from a system of calls and a kind of chatter such as exists among the higher animals of to-day, and an existing motor centre was put to a new use.

The motor centre or centres for the control of the muscles of the lips, tongue, and throat had parts of their substance gradually set apart for the modification of the voice in speech, and either in it or in an associated centre the power to record the memory of the words produced and learnt became established. No new cohesion or association of centres by tracts of fibres was necessary; as voice became articulate and speech became precise, old centres enlarged to meet new needs. But the acquisition of speech made higher thought possible by giving an exact means of expressing it, and by making the expression of abstract ideas possible. By signs and gestures, even when aided by inarticulate vocal utterance, only the immediate wants of an animal can be expressed, and amongst the deaf in our own time gesture language is not capable of expressing exact thought or abstract idea. It is upon this acquisition of speech, say after the age of fifteen to eighteen months, that the rapid mental development takes place, which, even before he goes to school at the age of five or six years, places the child far ahead of the most advanced and experienced animal. It was the acquisition of speech by primitive man which made his rapid advance in mental power possible, and which in the brain is shown by the greater relative bulk of the cerebrum. This setting aside of parts of existing centres for highly specialised purposes has been repeated in the history of the human race. A part of the auditory centre has been set apart for word-hearing and a part of the visual centre for word-seeing; and, when we come to study the phenomena of word-deafness and word-blindness we shall see that these are quite compatible with otherwise perfect sight and hearing.

The acquisition of speech by the race has been attended by some relative disadvantage. Equipped with his higher power for the exact expression of thought and feeling, the need for the great acuteness of the other senses, such as smell, became less. The sense of smell in the dog and deer is infinitely more acute than in man, and the eye as an optical instrument is in many ways far inferior in man to what obtains in some families of the lower creation; but the possession of speech, which has rendered the exercise of smell and sight for the purposes of self-preservation less necessary, has conferred on man advantages which far outweigh these relative losses.

In speaking of the acquisition of speech by the young child, Bastian¹ says—"The potentiality of attaining to such a power the child receives in the main as an inheritance from so many antecedent generations of men that its actual manifestation—the acquisition, that is, of the power of speaking—can only be regarded as a motor achievement of an order similar to some of those which may be included amongst the instinctive acts of lower animals, the similarity being not so much with the instinctive acts that animals are born with the capacity of performing, but rather with those which manifest themselves a little later in life, and which (from the more gradual acquirement) might be thought not to be instinctive acts at all. . . . Slowly elaborated developments of the parts of the medulla and of the brain concerned in the acts of speech we may presume had taken place in remote individuals of the present race as they acquired additional powers in this respect, and the power of developing similar structural connections between nerve cells and nerve fibres thus established having been handed down and rendered more perfect by hereditary transmission through countless succeeding generations, the infant is born to-day, perchance, with the potentiality of developing a nervous system as complex and as perfect in this respect as any which may have preceded it in its own ancestral line."

Possessed of the power of speech, and with a desire to have some permanent record of his thought, man invented the art of writing. At first this form of language was, like that which preceded speech, natural and graphic, and consisted of picture-writing. Later, with the invention of the alphabet, it became, like speech, artificial and conventional. But while speech is a mere symbol of the thing represented by the word, the connection between writing and the thing it represents is even looser. It is but the "symbol of a symbol," for when we write or read a word representing an object, we think of the object through the word, and in most cases where the power to call up, by what may be called internal speech, the name of the object is lost, the power to write or read the word is also lost. Only in the more highly-trained intellects is it possible to do without this intermediary internal speech, and write or read the name of the object directly.

The centre for speech is, in part at least, a motor centre, and in this respect differs from those for sight and hearing. These latter are purely sensory. The memory of words spoken is largely a memory of movements made by the muscles of

¹ *The Brain as an Organ of the Mind*, fifth edition, 1902, p. 604.

articulation, and must be distinguished from the memory of words heard. This distinction is of importance with regard to the practice of speech and of lip-reading by the deaf.

In the processes of thought, these associated language centres for vision, hearing, writing, and speech co-operate, and though all are not used in every thought process, yet all are called in when the thought process is at all involved or obscure. If a stranger ask a native for a little-known street, the latter will often repeat the name of the street audibly before giving his direction to the stranger, thus making his speech and auditory centres co-operate in recalling to his mind the locality of the street wanted. If one have difficulty with the spelling of a word, the correct spelling is often quickly arrived at by writing the word and looking at it, thus calling in the visual to the help of the auditory and speech centres. The comprehension of an obscure passage in a book is often improved by reading the passage aloud, the auditory and speech centres being thus called in to the aid of the visual centre in unravelling the meaning of the language employed. In this last instance, centres which had become automatic in their operation, and which demanded no separate act of attention, were called in—that is to say, audible speech assisted the higher centres in the comprehension of the obscure meaning. But the opposite of this is sometimes the case. If an Englishman, learning French, read the foreign language aloud, with the object of improving his pronunciation and accustoming his ear to the sound of the half-learnt language, he will find that the comprehension of the passage is more difficult than it is when read silently, and he may fail altogether to reach the meaning unless he take to silent reading. In this last instance the operation of the motor speech and auditory centres is not automatic—they require increased attention, and their addition to the circuit of thought centres obscures rather than aids comprehension. This explains what is found in orally taught deaf children, that, in the later years of their school life, speech sometimes deteriorates because their attention is being occupied by efforts at the comprehension of more difficult language, and as less of it is given to speech, the latter becomes less distinct; and it supplies the physiological reason for devoting the earlier years of school life to speech and lip-reading, and only beginning writing and more difficult language training after speech has become as nearly automatic as possible.

The use of the term “automatic,” as applied to the operation of the language centres, requires a little explanation.

It is used in the sense of "secondarily automatic" as against the primarily automatic operations of breathing, circulation, &c., which are in operation from birth, which continue irrespective of the child's will, and on which his continued existence depends. But none of the special senses are automatic at birth; all have to be trained before they become automatic. All children are born deaf and blind. It is many days before a young child can be startled from his sleep by a loud noise, or before he can be made to follow a bright light with his eye. Further, none of the language centres becomes automatic over the whole field of possible experience. The most acute eye will fail, without some training, to appreciate all that can be seen in a field of the microscope, and the most acute ear requires training or repeated experience before it can appreciate the features of a fugue or a sonata. The term "automatic" is, therefore, a relative one with regard to the eye and ear, but it is much more so with regard to the

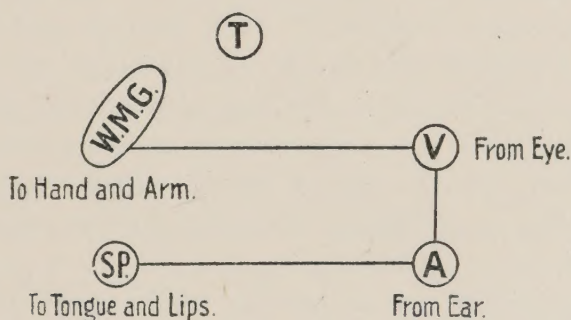


FIG. 4.

Language centres in the normal child.

Sp., motor speech centre (glosso-kinæsthetic centre); WMG, writing, manual alphabet, and gesture centre (cheiro-kinæsthetic centre); A, auditory centre, including auditory word centre; V, visual centre, including visual word centre; T, touch centre.

operation of the speech centre. This centre is not called into action nearly so soon in the life of the child as are those for the eye and the ear. But a time comes in the life of a child when the use of a vocabulary of common words becomes automatic, and then the inclusion of the speech centre in the circuit of difficult thought processes renders it useful or beneficial to the latter. This process is a continuous one in the life of a child, more and more difficult words being added to the automatic vocabulary.

It is not contended here that speech is of no use in assisting thought unless it have become automatic, but it is contended that unless it have become so, it is not spontaneously called in to the aid of the more difficult thought processes.

During the process of silent thought, words are revived

and used as the symbols or counters by means of which the process is carried on in the thinker's mind. This may occur in a normal individual in three ways—(1) There may be a revival of the sounds of words as we hear them read, or as we hear ourselves use them in ordinary conversation; (2) there may be a revival of the appearance of words as we see them after we have written them, or as we see them on the printed page; (3) there may be a revival of the feelings or sensations produced by the articulation of words. Probably most of us think in mixed images, but there can hardly be any doubt that, in carrying on this internal language, the revival of the sounds of words is the commonest, or, rather, the most conscious experience we undergo, hence most people are called "auditives," whilst those who think in revived word appearances, whether written or printed, have been called "visuals."

A good deal of controversy has occurred about the revival of words by the third method—as motor processes. Hughlings Jackson, Stricker, and Ballet hold that words are generally revived as faint excitations of the processes occurring in motor centres during the articulation of words, and each quotes his own experience as supporting this contention. Bastian, on the other hand, supports the view that words are revived in ordinary thought in the main as auditory ideas or images.

When from disease in a young child one or more of the language centres is thrown out of the circuit, the disturbance to, or impairment of, thought varies with the centres affected.

The condition of the blind child is not so difficult as at first appears. No doubt one of the great gateways has been closed, but it is that by which general effects rather than expressions of exact thought reach the brain. And with perfect hearing his speech develops with scarcely lessened pace, so that intellectually he is scarcely less fit to enter school than the ordinary child. His ability to appreciate accurate expressions of thought reaching him by the sense of hearing, and to respond by equally accurate expression through easily understood speech, makes rapid intellectual development possible. Internal language may be carried on in the blind child, as it is chiefly in the normal child, by revived auditory impressions or by revived motor impressions, but never by revived visual impressions. There is, however, a third possible method, namely, by revived touch impressions, touch taking the place of sight.

If the position of the young blind child is better, that of

the deaf-born child is worse than at first sight appears. No doubt, broad general effects are expressed to him through the sense of sight, and an indefinite language of natural signs is learnt. Without hearing, however, he has no means of receiving expressions of exact thought, and without speech he has no means of formulating his own thought in exact terms, so that he commences his school life at seven years in much the same condition intellectually as a hearing child of two years. In

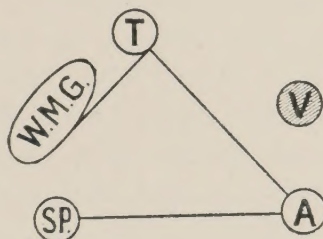


FIG. 5.

Language centres in the blind child.

References as in Fig. 4. The centre for vision is out of the circuit, and touch has taken its place.

the interval between two and seven years his intellectual development has been arrested, and this arrest has its physical expression in the relatively smaller head of the deaf-mute child. Further, he meets his teacher without any stock of words to begin with, and the early years of his education are spent in getting together some form of verbal language. In carrying on internal language he cannot

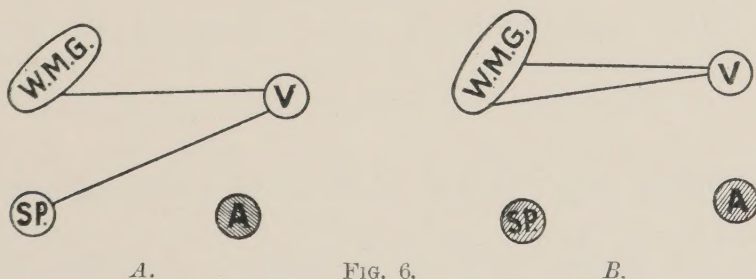


FIG. 6.

Active centres in the deaf. A. The orally taught child (only A is inoperative). B. In the manually taught child (both A and Sp are inoperative).

Sp., speech centre; A, auditory centre; V, visual centre; WMG, writing, manual alphabet, and gesture language group of centres.

be an auditive; he must be a visual or a tactual. Sometimes his speech becomes so automatic that he thinks by recalling the movements of his lips and tongue as used in speech. On the other hand, his eyes have been so accustomed to take the place of his ears that he may easily think in the revived impressions of words as seen on the printed page, or as seen on the lips or

hands of those who have spoken to him. He must always differ from the hearing child, and even from the semi-mute child. These latter have used their auditory and speech centres so long that their influence can never be wholly eliminated from the thought processes. The congenitally deaf child has by six or seven years become such a confirmed "visual" that visualising is apt to predominate in his thought processes.

The following conversation between Dr. Forchhammer,¹ of the Nyborg Institution for the Deaf, and his congenitally deaf wife illustrates the composite nature of the picture formed by thought symbols, and the difficulty of apportioning the relative value to each. Mrs. Forchhammer has full command of the Danish language, and is a good lip-reader.

Dr. F.—"How is the thinking process carried on by you?"

Mrs. F.—"In pictures almost always as if the events were present before my eye."

Dr. F.—"When you have read anything, do you afterwards, when thinking of it, see the letters before your eyes?"

Mrs. F.—"No."

Dr. F.—"When you have been spoken to, do you think of the words as seen on the mouth of the speaker?"

Mrs. F.—"No; it is as if I said it myself."

Dr. Forchhammer, on a later occasion, tried in another way by asking her to recall something he had just said, and enquiring how she retained it.

Mrs. F.—"I think both of the subject and of the speech."

Dr. F.—"Do you think of my mouth or of your own speech?"

Mrs. F.—"I believe, of my own speech; it is as if I spoke myself."

Dr. F.—"What do you think of most—the speech or the subject?"

Mrs. F.—"I cannot tell—it is such a difficult matter to settle."

It would thus seem that amongst the congenitally deaf there is the same variety in the use of the symbols of thought as amongst the hearing, with the exception that the former are never "auditives."

The demand that the deaf think in one definite manner is not justifiable so far as the accuracy of the thought process is concerned. The important thing is that the symbols have become so familiar to the deaf person that their use does not require any separate act of attention.

¹ Communicated to the writer for the purposes of this paper.

There is, however, one difference between the use of speech on the one hand and finger-spelling on the other regarding their value in thought processes. In finger-spelling, however rapid, the result reaches the eye in the form of separate letters, and not of whole words or even syllables. With speech the movements, however complicated, reach the eye as whole words or syllables, just as they reach the ear. Take the words "clang," "plough," and "through." Each of these reaches the eye of the lip-reader just as it reaches the ear of the hearing person as a single effect, whereas they reach the eye when spelt on the fingers as five or six separate impressions. No doubt as isolated words they are much more apt to be wrongly read by the deaf when spoken than when spelt, but the association in which they occur reduces greatly the risk of error. When the lip-reader is successful, his thought should be more rapid.

The condition of the blind-deaf child would appear at first

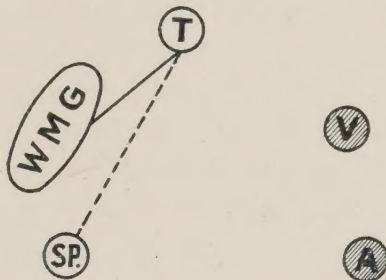


FIG. 7.

Language centres in the blind deaf. The only active associated fibres are those between T and the group WMG, unless speech be taught, in which case Sp. is brought into the circuit.

sight to be quite hopeless, and up till recent years was regarded as such. But he has one great gateway or avenue left—the sense of touch. Now, the information which reaches the blind-deaf through this channel is necessarily given very slowly; but, as it is given by means of a verbal language, it is capable of being expressed accurately, and it confers on the blind-deaf the power of responding in equally accurate terms. Intellectual development is, therefore, possible in theory to any extent by this means. In practice, such development is limited by the amount of time and patience required by both teacher and scholar to get good results.

Conspicuous cases of success have occurred, and chief amongst those are Laura Bridgman and Helen Keller. When I asked Miss Keller what effect she thought the acquisition of speech had on her, she replied, after a little thought,

"It made me think three times more quickly." Now, before she learnt speech, Helen made remarkable progress. Every presentation reaching her through her sense of touch was arranged and packed carefully away for reproduction just when needed. Similarly, every successful finger-spelling movement could be repeated with a readiness unusual in children. In other words, she had a splendid memory. What reached her she retained. What she did once she could repeat easily. But in her brain, till the age of ten years, only two centres were engaged in the regular work of education. The centres for vision and hearing were out of the circuit, the centre for touch alone was used for ingoing impressions (language appreciating centre), and the centres for movements of the arm and hand, as used in spelling the American or single-handed manual alphabet, was used by her in response as an outgoing centre (language producing centre). But when, on Helen making the demand, "I must speak," the old centre for speech, rendered apt for the expression of exact thought and abstract idea by thousands of years of hereditary use, was called in, she felt she had entered a new world, and exclaimed, "My soul, conscious of new strength, came out of bondage, and was reaching through these broken syllables to all knowledge and faith." She forthwith thought more rapidly and accurately.

In the blind-deaf who do not speak, internal language must be a series of revived touch impressions or of revived motor processes, the movements being those used in the spelling of the manual alphabet.

I have recently made further enquiry at Miss Keller with regard to her process of silent thought. In reply, she states that she often feels herself mentally talking with her lips; she also feels herself to be spelling with her fingers. When she thinks of something she has read she says she conceives the words in Braille points.

In her recently published book, *The World I Live in*,¹ she states, "I cannot represent more clearly than anyone else the gradual and subtle changes from first impressions to abstract ideas, but I know that my physical ideas—that is, ideas derived from material objects—appear to me first in ideas similar to these of touch. Instantly they pass into intellectual meanings. Afterwards the meaning finds expression in what is called inner speech. When I was a child my inner speech was inner spelling. Although I am now frequently caught spelling to myself on my fingers, yet I talk to myself, too,

¹ Helen Keller, *The World I Live in*, 1908, p. 146.

with my lips, and it is true that when I first learnt to speak my mind discarded the finger symbols and began to articulate. However, when I try to recall what someone has said to me, I am conscious of a hand spelling into mine."

Now, Miss Keller learnt speech at ten years, before which she thought in spelling (individual letters), after which she thought in articulation processes (words).

If the modern view that the language centres are not areas rigidly mapped off from one another, but areas within which each special function is most active, a physiological examination of Miss Keller's remarkable mental power is here suggested. She declares that it is through her sense of touch that so much which usually reaches us through eye and ear comes to her brain, and her account of what comes to her by touch is from the physiological side a valuable and original series of observations. May not the cell-growth of the touch centre and its connections have extended during her early years at the expense of the contiguous grey matter which was inactive, and may not the grey matter of the touch area of the brain surface in her case occupy a relatively greater area than it does in normal people? This must always remain only a theory, but histologically there is no known difference in the grey matter forming the different centres behind the fissure of Rolando. Further, such a theory is in no way incompatible with what was stated at the beginning of this paper, viz., that in normal children, where the usual stimuli are in operation, development of function proceeds within rigidly fixed lines governed by heredity and anatomical connection.

An interesting paper by Professor Pawlow,¹ on what he calls "Conditioned Reflexes," may be referred to. The presence of food in the mouth, an "unconditioned stimulus," produces a flow of saliva. But usually the sight or smell of food produces the same result. Such is a "conditioned stimulus." Pawlow found that if in a dog such a conditioned stimulus be repeated often—for some days or weeks—without the particular food being actually given, it loses its power to excite the secretion of saliva by presentation to the nose or eye.

He next substituted a new conditioned stimulus for that usually supplied through the nose and eye. When food was placed in the dog's mouth, a given note on the piano was struck, and it was found that after thirty or forty repetitions of this, the striking of the piano note alone produced by itself

¹ Huxley Lecture, *Lancet*, 6th October, 1906, p. 911.

the flow of saliva. Further, he found that the varying of this note by even a quarter of a semitone was enough to interfere with the salivary response.

Now, such physiological alterations in the methods of response to stimuli cannot take place without corresponding changes in the brain substance, viz., new cell cohesions and developments.

No wonder the sense of touch in the blind becomes developed and apparently more acute to a remarkable degree, and as in the blind the alteration in the circuit is permanent and not as in the dog (see above experiment), temporary, it seems fair to assume that the touch area of the cortex becomes permanently extended at the expense of contiguous unused areas. Thus, Miss Keller's marvellous use of her sense of touch finds a physiological explanation, and the same argument applies to her scarcely less marvellous use of the sense of smell.

Alongside of Helen Keller's case may be put that of Laura Bridgman. The latter is not only of great value as a physiological study, but also because it made success with the former possible. The chief initial difference between the two, looking at them as subjects for the operation of the language centres, is the almost total absence of the sense of smell from Laura's case. Helen's use of the sense of smell undoubtedly raises it to the position of a true language centre, a position it does not occupy in the normal child. In connection with the theory put forward above with regard to the acuteness of Helen Keller's sense of smell and touch, the description of the brain as found at Laura Bridgman's autopsy is valuable. "The examination of the brain showed that those portions which from youth up could not be brought into activity in the ordinary way through external impressions, viz., all the cerebral nerves, were small; the gustatory nerve, the auditory nerve, and a nerve that moves the eyeballs were stunted, and this was specially true of the tract of the optic nerves. The cerebral hemispheres appeared somewhat flattened behind, and the occipital lobe, in fact, smaller on the right than on the left, and the right cuneus much less developed than the left. This difference in the region belonging to the visual centres is intelligible when we consider that Miss Bridgman from her second year was completely blind with the left eye, whereas with the right she retained some sensation of light until her eighth year, enough, at anyrate, to allow the development of the centres of the left side to go on."

Assuming these details of the autopsy of the brain to be

correct, we have proof that the loss of function of, or the absence of, the end organs in the eye or ear is accompanied by a shrivelling of the tracts leading to the brain, and of the parts of the brain connected therewith. The writer has shown that in deaf-mutes the delay in development of the language centres is associated with a less size of the head than holds in the normal child.

Is it not reasonable to suppose that the greater use of the senses of smell and touch which took place in Helen Keller's case has been accompanied by a corresponding increase of the cortical areas belonging to those centres?

Looking now to the operations of the language centres proper, the chief difference between Helen and Laura is the possession of speech by the former. There is no doubt Laura Bridgman could have been taught to speak, and Dr. Howe, her teacher, ultimately regretted that he had not taught her speech. But the acquisition of speech would never have made Laura Bridgman into an Helen Keller. Long before the latter had learnt speech she showed a mentality which Laura Bridgman never reached. The interesting thing about Laura is not that she was never taught speech, but that without teaching she had a vocabulary of fifty or sixty words, or at least of articulation movements which passed for words, and which she used with accuracy chiefly for the designation of persons of her acquaintance. These words were, according to Dr. Lieber, all monosyllabic, and in her use of them she resembled children and uncivilised tribes. A poor vocabulary, one may say, but a very eloquent testimony to the heredity of the tendency to speak. Laura never spoke sentences; when she used language in her sleep, it was the language of the manual alphabet.

Dr. Lieber says,¹ "Laura was positively interrupted in the formation of her imperfect and elementary phonetic language in order to make her a being of intercourse in our society—in order to attach her as a living member to the community of civilisation. This could not have been done had she been allowed freely to indulge in the harsh and grating sounds which excited souls utter forth through a throat untaught and unbred, so to say, by the harmony of developed civilisation in which we move."

Like Laura Bridgman, Helen showed the hereditary tendency to speak when she said, "I must speak." What she aspired to was hardly considered possible.

Side by side with Dr. Howe's great work (the teaching

¹ Maud and Florence Howe, *Laura Bridgman*, 1904, p. 244.

of language to the blind-deaf) must be put Helen Keller's (the acquisition of speech by the blind-deaf)—the greatest individual achievement in the whole history of oralism, or indeed of education.

But it was well for Helen that she was not born in 1829, as Laura Bridgman was. For fifty years after that the teaching of the deaf in America was manual, as introduced by the elder Gallaudet, and Helen Keller's cry, "I must speak," would, in spite of her own great genius, have been vain.

Although an attempt has been made here to show the operation of the language centres in these two remarkable cases, there are two points which must be borne in mind. Both heard and saw for the first two years of life, and although neither in later years could recollect colour and sound impressions, it does not follow that such impressions had no influence in their later thought processes. It is almost certain that such an influence continued.

On the other hand, no attempt is made here to account for the mental result in Laura Bridgman and Helen Keller as the product of the language centre alone. It seems to the writer even more difficult to do so (especially in the case of Helen Keller) without postulating the existence of a soul than it is in the case of the normal individual.

A short study of aphasia, with the related conditions of word-deafness and word-blindness, is useful in two ways. It helps us to understand the mechanism of speech, and it throws light on the management of a small class of extremely difficult, but also extremely important, cases amongst backward children. It will also help the understanding of the difficulties of the deaf and blind.

The cortical centres concerned in the reception and production of language are the visual and the auditory on the one hand, and the centre for speech and writing on the other.

With the writing centre may, as we have seen, be included the manual and gesture language centres, because writing is only putting down on paper by one set of conventional signs what the hands write in the air by another set, whilst in all three the same set of muscles—those of the hands and arms—are those chiefly engaged. Now, in children, education may be hindered by damage to the terminal organs, the ear, and the eye, or to the auditory and optic nerves leading from these terminal organs to the corresponding centres in the brain (see Fig. 4). As a matter of fact, such is the usual location of the disease causing deafness in the deaf and dumb and blindness in blind children. In both cases the correspond-

ing cortical centres, A or V, is permanently out of the circuit, and a less habitual route has to be chosen to complete the circuit. In the blind, A-Sp., the usual route for the ingoing of accurately expressed ideas, is still open, the education of the child proceeds apace, and touch is made to take the place of sight. But in the deaf, A-Sp. is unused, and Sp. as a motor centre with storing power is lost to the brain, unless where speech is developed through some other channel than hearing. It is true that by a verbal language, such as writing or the manual alphabet, accurately expressed ideas may be conveyed, the ingoing being by V and the outgoing by W to the hand. But Sp. remains unused, so that the finger-taught deaf child has lost two storing centres, Sp. and A, whilst the orally-taught deaf has lost only A (see Fig 6, *a* and *b*).

Within the brain education may theoretically be hindered by damage to any of the four centres, Sp., A, V, or the group WMG, or to the fibres associating these centres. As a matter of clinical experience, damage takes place in both situations, but in children such damage is limited in practice to the centres, the associating tracts being seldom affected in those who are capable of attending school at all.

In *true motor aphasia* of adults the centre Sp. is damaged. The damage is commonly due to embolism of, or bleeding from, a vessel leading to the lobe or convolution of Broca, in which the centre for speech is placed.

Although a speech centre exists on both sides of the brain, the working centre has come by heredity to be placed, in right-handed people, on the left side of the brain, and in left-handed people on the right side.

In children this speech centre is occasionally congenitally imperfect, and we have those cases of dumbness with perfect hearing, and otherwise normal intelligence, which come to the schools for the deaf and dumb for admission (congenital aphasia).

When aphasia occurs in an adult it occurs suddenly; all memories of words which have been spoken by the patient are destroyed or much impaired, and, unless he be one of those who has been able to carry on his silent thought without the medium of internal speech, his mental processes are also greatly impaired.

Word-deafness may be also either congenital or acquired. Hearing for musical sounds, or even for the letters which compose words, may be and is usually perfect, but the auditory memories for spoken words are destroyed. Internal speech, if the patient has been a strong "auditive," is interfered with,

for the patient can no longer carry out that mental audition which formed part of his processes of silent thought. If he has been a strong "visual," accustomed to take direct from the page without the intervention of internal speech, he can still read, the mental disturbance is less, and the disturbance to motor speech is but slight.

In *word-blindness* the process of memorising written or printed words is interfered with. In other respects sight may be, and usually is, perfect, and, apart from the difficulty of learning to read, the child in a congenital case may be a bright pupil.

There can be no doubt that, whilst these cases of congenital word-blindness are not common, they occur amongst school children, and account for some of the cases of almost inscrutable backwardness in language which occur in otherwise smart children.

The following case, quoted from Dr. Hinshelwood, illustrates the difficulty in a case of congenital word-blindness:—

"A boy, aged 11 years, was at school for four and a half years, but was finally sent away because he could not be taught to read. His father informed me that he was a considerable time at school before the defect was noted, as he had such an excellent memory that he learned his lessons by heart; in fact, his first little reading-book he knew by heart, so that whenever it came to his turn he could from memory repeat his lesson, although he could not read the words. His father also informed me that in every respect, unless in his inability to learn to read, the boy seemed quite as intelligent as any of his brothers and sisters. His auditory memory was excellent, and better than that of any of the other members of the family. When a passage was repeated to him aloud he could commit it to memory very rapidly.

"When I first saw the boy and his father at the Glasgow Eye Infirmary I asked them to call on me at my house, and I wrote down the address on an envelope. A few days thereafter the father could not find the envelope, but the boy at once repeated the address correctly, having remembered it from hearing me state it once.

"I examined the boy first on 4th March, 1900, when he seemed a smart and intelligent lad for his years. He knew the alphabet by heart, repeating it rapidly and correctly. He could recognise by sight, however, only a very few letters, and those not with any degree of certainty. He could spell correctly most simple words of one syllable, such as 'cat,' 'dog,' 'man,' 'boy,' &c., but he could not recognise by sight

the simplest and commonest words, such as 'the,' 'of,' 'in,' &c. He had no difficulty in recognising all other visual objects, such as faces, places, and pictures. On each page of the little primer in which I tested him there was a picture of some object which was followed by some simple letterpress about it. He at once recognised each picture, *e.g.*, a cat. I would then ask him to spell the word, which he nearly always did quite correctly. On asking him to pick out the word 'cat' on the page he was unable to do it. I repeated this experiment on page after page of the little primer. On testing him with figures I found that he could repeat from memory fluently and correctly numbers up to 100. He could also perform mentally simple sums of addition. He could not, however, recognise all the figures by sight, but he knew them better than the letters, and recognised a greater number of them.

"Since 4th March I have seen the boy every week; I last saw him on 22nd April. I asked the father to keep him constantly practising at his alphabet, and at the figures up to 50. By dint of constant and persevering practice during these seven weeks he is now able to recognise many letters of the alphabet, but he has not mastered them all. Still, the result of the seven weeks' work gives us the hope that by perseverance he will gradually acquire the power of recognising the letters by sight. Whether he will ever be able to acquire the visual memory of words, so as to read by sight, is, however, very doubtful. The task of acquiring the visual memory of words is immensely greater than that of acquiring the visual memory of letters, of which there are but fifty-two in the English alphabet, including capital and small letters. But if he acquires the visual memory of the letters he will be able to read slowly by spelling out aloud each word letter by letter, and thus appealing to his auditory memory, which is excellent. His progress with the figures was much more rapid. He can now recognise them all up to 50. His father has always observed that he did not experience the same difficulty with figures as with letters. As his father expressed it, 'they came more readily to him.'"

We now come to a group of children, the mentally deficient, in which the abnormal conditions which obtain in the brain are essentially different from anything we have yet seen. In all the cases yet considered, an end organ, the ear or the eye, or both, have been damaged, or a language centre, that for sight or hearing, or both, are either congenitally or post-natally diseased. The effect of these changes is to disturb

the processes of thought, but the effect is not serious or profound where the centre for speech is not involved. Except, therefore, in the deaf, the problem before the educator is not a difficult one, for it is easy to educate the speech centre by a less used route where hearing is not destroyed.

But in the mentally deficient it is in marked contrast to all this. The language centres are either perfect or but slightly deficient. The eye affection, if one exist, is usually a refraction error, which may be corrected by lenses. Hearing is usually perfect. Speech may be perfect, but if it be absent or very deficient, it is not because the speech centre is diseased, but because the child has no ideas to express. He is probably the subject of a lesion of the frontal lobes of the brain, where the higher psychical centres are placed. In the blind, in the deaf, and in the aphasic these higher psychical centres are perfect, and it is merely a question of taking trouble along the right lines, on the part of the teacher, in order to fit the pupil for the work of life. With the mentally deficient, except in the slightest cases, taking trouble along any line or lines is repaid by but poor results, and the child never becomes anything but a pitiable dependant on the efforts of others.

Throughout this paper hints with regard to the education of abnormal children have necessarily been dropped, but general principles on which their education should be conducted may now be drawn:—

1. It is useless hammering along a ruined tract or along a sound tract towards a ruined centre in the hope of imparting knowledge to a really deaf and blind child. It is better to use a circuitous though less used route. To ignore this principle is like pulling a bell with the wire broken, or knocking at the door of a tenantless house. In the *very* deaf and the *very* blind, therefore, slight remains of sight and hearing are useless and should be ignored.

2. Where the remains of sight and hearing are considerable—where in the deaf they serve for the discovery of vowels, consonants, and words; in the blind, for what under favourable conditions of light, &c., is written on a book or a black-board—these should be used to the utmost. This principle provides for the oro-acoustic education of the semi-deaf and for the education of the semi-blind in smaller classes by the ordinary educational means.

3. When a circuitous route is necessary, education should be directed so that Broca's centre, the hereditary centre for the memory of spoken words, is used. It is not contended

that accurate or abstract thinking is impossible if this centre be ignored; but if it be ignored, a highly specialised brain centre is left out, and the mechanism of thought has to be conducted without one of its most valuable resources. Now, inasmuch as blindness leaves the tract A-Sp. intact, the lines on which the education of the blind must proceed are simple; but educators of the deaf differ as to whether, seeing A is destroyed, it is worth while reaching Sp. by a circuitous route. Thus, from the physiological side there is raised the old war of methods—oralism versus the manual alphabet language. The oralists try to reach Sp., and to reach it through V; the manualists ignore Sp., and establish a new verbal language centre at the group W M G (Fig. 3). Now, in this controversy, physiology takes the side of the oralist. Where V is good, or, in other words, where the child's sight is good, and where the child is not mentally deficient, Sp. can be reached, and in doing so not only is an additional part of the brain used, but this part is the hereditary centre for the memorising of words. Thought in the orally taught deaf should, according to physiology, be more accurate and more rapid. In the blind-deaf, progress along any line is extremely slow, but physiology again points to the great advantage of calling in the regular exercise of the centre for motor speech, and Helen Keller's experience, as we have seen, agrees with the teaching of physiology.

4. In congenital word-deafness and congenital word-blindness our experience is as yet very limited. Many of these cases are never discovered, and are passed off as stupid children, the real cause of the dulness never having been discovered. But when a boy is clever with his hands and good in his games, where the difficulty is chiefly with his acquisition of language, word-deafness and word-blindness should be sought for. Dr. Hinshelwood finds that progress is made in time by the word-blind by repeated short reading lessons, and thinks that this is due to the right side of the brain gradually taking up the duty usually performed by the left visual centre. But although education in reading may be slow, general intelligence may proceed apace, for the auditory speech path is open.

5. In the teaching of the aphasic child who is not mentally deficient, Broca's convolution on the right side, unless the defect be bilateral, may be made to take up the work of the hereditary speech centre of the left side. Where failure shows that the defect is probably bilateral, education may proceed by the help of writing and the manual alphabet.

6. Mentally deficient children offer a different problem to the educator. These children are found not only in the ordinary elementary schools, but in the schools for the deaf and in those for the blind. The great need of the moment is to recognise their limitations. The deaf who are also mentally deficient cannot be taught orally, and should reside permanently in institutions, even during their adult life. The same provision should be made for the blind who are mentally deficient. The mentally deficient who both hear and see should, if they make slow progress—progress so slow that it offers no prospect of their ever becoming self-supporting—also be provided for permanently in asylums. In the slighter cases, however, special education in smaller classes enables the children to be placed later in their school career in the ordinary classes of the elementary schools.

The writer's idea in this paper is that, having due regard to the physiological indications present, the teacher should be left as free as possible in selecting the method and in ordering the education of the abnormal child. Even at the risk of appearing to restrict the liberty of the teacher, the writer would lay down some other physiological indications with regard to the education of the orally taught deaf—

(a) As signs are used very extensively in the early teaching of the hearing child—during his first and second years of life—there is no physiological reason for suppressing them at the beginning of the school education of the deaf child. They should be used just as they are with hearing children, and excluded, as in the case of the latter, as soon as the more accurate equivalent has been learnt. They are like a finger supporting a child during its first attempts at walking, or like a crutch used during the recovery of the function of a broken limb, or, as the writer has elsewhere spoken of them, they are like the scaffolding necessary during the erection of a building. The finger, the crutch, and the scaffolding must alike go, never again to be used, except in times of danger or great difficulty.

(b) During the early years of school life the acquisition of articulate speech should be the chief business of the deaf child. As soon as may be, a vocabulary of common words should be so thoroughly learnt that its use in speech becomes automatic. This means slow intellectual progress during the first two or three years of the deaf child's school life. But it means better intelligence and better language in the end if the school course can be made long enough. Freed from the necessity of giving separate attention to the mechanism of his

speech, the child will be able to give his undivided attention to the subject of his thought. Clearly the school period of a deaf child's life cannot be fixed in number of years but by a standard of attainment. In this connection, a distinction must be drawn between the semi-deaf and the semi-mute child on the one hand, and the toto-congenitally deaf child on the other. The latter, when he enters school, has thought in visual symbols or counters for so many years that it is certain that these will always bulk largely in his thought processes. Whether it is worth educating him orally will depend on the length of time the school course is to last and the rate at which he progresses. But the semi-deaf are, like the hearing, largely auditives, and both they and the semi-mute have a vocabulary which is automatic, and which it should be the first concern of the teacher to preserve. These, therefore, the semi-deaf and the semi-mute, should under all circumstances be taught orally.

(c) In the education of the deaf, drawing should follow speech and precede writing. This is the order which has been followed in the history of the human race, it is the order which is naturally followed by the hearing child, and it is the order which will best suit the mental development of the deaf child. The picture-writing of the earlier races, and the early efforts of the young child to imitate, by drawing the things that he sees, are generically the same. The use of conventional written symbols for those other conventional symbols which we call words came later in the history of the race, comes later in the natural history of hearing children, most of whom draw before they go to school, and should come later in the history of the deaf child.

(d) Until speech has become automatic no finger-spelling should be known to a deaf child. A combined method, where the combination is that of finger-spelling and speech, is, from the physiological standpoint, to be condemned. This means the banishment of the manual alphabet from the schoolroom of the orally taught for the first years of school life. If the visual and motor speech centres are to be developed for the purposes of speech and lip-reading, the child must not be distracted by the attempt to acquire another set of conventional motor signs like the manual alphabet. In the later years of school life, physiology would not condemn the practice of the manual alphabet by the child whose speech had already become automatic, but in practice, and for reasons quite apart from physiology, it is undesirable to introduce manual spelling into the oral schoolroom at all.

(e) The difficulty of procuring automatic speech in the deaf-born, while necessarily limiting the use of speech by these children, does not mean that it is not worth while teaching them speech. As a means of communication with others speech has an advantage over all other forms of language, which makes its acquisition by all classes of the deaf desirable. In *The Study of the Deaf Child* the writer has taken up this subject at some length, and need not further refer to it here. But the difficulty of procuring automatic speech in the deaf-born points to the great advantage of commencing speech training at a much earlier age than is now the rule, namely, six or seven years. By commencing speech training at two or three years, before the child has become a confirmed "visual," the ultimate value of speech in the processes of thought should be greatly enhanced.

DEAFNESS IN THE SCHOOL CHILD.

I HAVE dwelt thus long on the question of language centres for a special reason. Two Acts have recently been passed by Parliament—the Scotch Education Act of 1908 and the Children's Act—which taken together may be called the Neglected Child's Charter. I do not stay here to criticise these measures. I rejoice over their passing, and I feel sure that public sympathy and help will be extended to School Boards and to Local Authorities in carrying out their provisions. But as teachers I ask you to remember that your prime business is to educate, and that the two great gateways of knowledge are the eye and the ear. The Sanitary Authority may clean the school child, the School Board may feed him and cloth him, and the Police may protect him, but only you can instruct him; and to do so successfully he must have a sound eye and ear, or, if he have not, then you must alter your teaching methods to meet the defect. I therefore proceed to deal with deafness in the school child.

The two great causes of deafness in school children are "a running ear" and obstruction of the back of the nose by adenoid growths. (I am not speaking of deaf and dumb children, most of whom become deaf from other causes affecting almost invariably the internal ear.) These are often present in a single case, and where so combined the adenoid growths may keep up the running of the ear, which, were the growths removed, would soon cease suppurating.

There are other causes of deafness than these two (such as syphilis), but such cases are not very common, and must be left to the medical man for diagnosis from the first. But without trenching on the province of the doctor, the teacher may get presumptive evidence of the existence of these two common causes of deafness, and thus help the doctor in his work.

The term "running ear" is rather a misnomer, for often the discharge is so slight that it cakes in hardened masses deep in the ear canal and never appears at the outside at all. But if before a good light the auricle be pulled well upwards and backwards, the presence of discharge or wax which is not otherwise visible may be discovered by the teacher. If the discharge be profuse it appears at the outer end of the ear canal, where by its irritation it often sets up a skin eruption, or where it may cake in yellow or brown crusts. Continued ear discharge always causes deafness—the drum membrane gets ulcerated away, the ossicles get diseased and may be lost, the walls of the drum cavity become necrosed or die, and in some cases the infection passes through into the brain cavity and the life of the child is in great danger.

I do not think many children die during the school period of the intra-cranial complications of middle-ear suppuration, but I am sure that of the large number of those who later in life die of these complications, it is true that most originate during the school period, and by proper treatment are curable then. On the other hand, the death of the school child from the neglected running ear may occur. I have always under my care in the Royal Infirmary such cases, and some of them unfortunately die.

I do not know the number of running ears amongst the school children of Glasgow, but taking Dr. Kerr's estimate for London and applying it to our city, there are at least 1,000 children thus afflicted, and in many cases both ears are discharging. Were you a company of medical men I should have to show you that most of these cases are at present neglected, and that the present hospital arrangements of this city are quite inadequate to deal properly with this dangerous and hearing-destroying disease. But engaged as you are in teaching, I appeal to you to discover ear discharges as early in the school child's life as possible, for the longer such a discharge lasts the greater will be the destruction of hearing and the greater will become the risk to the life of the child.

The second common cause of deafness in the school child is the presence in the naso-pharynx or back of the nose of adenoid growths. These are fleshy-looking masses which fill up more or less completely the back of the nose, and when they are well developed turn the child into a mouth-breather. The mouth is not a breathing organ, and, unless under circumstances of great stress or exertion, should not be used for respiration. It is the function of the nose to warm and filter the air before it reaches the lungs, and where a child is

compelled to breathe by the mouth, because his nose is stopped, all sorts of bronchial and lung affections are apt to follow.

Here we are specially concerned with the effect of these adenoid growths on the sense of hearing, and it is well to remember that they may cause deafness and keep up suppuration of the drum cavity without being bulky enough to cause the child to breathe by the mouth. Adenoid growths cause deafness by interfering with the ventilation of the drum cavity. With each act of swallowing the mouth of the Eustachian tube opens and air passes up to the drum cavity. This air is gradually absorbed by the vessels of the drum cavity, and unless it be renewed from the throat, the drum cavity becomes a partial vacuum, the membrane becomes sucked or rather pushed inwards, and does not respond to sound waves which reach it through the external auditory canal. Deafness is the result.

But adenoids also hurt the ear by harbouring infective germs, which reach the ear from time to time and start or keep up suppurative changes within the drum cavity. When they are well developed—well enough to interfere with nasal breathing—they change the whole facial expression. The child sits with his mouth half opened and appears dull and stupid. The smart look which comes from the active use of the muscles about the nose and mouth is absent from the child's face, and this laxness of facial expression spreads to the upper half of the face, for even the eyelids tend to droop, and the whole face becomes flat and uninteresting. When the back of the nose is thus blocked by growths the voice of the child becomes altered. The naso-pharynx is no longer a resonating cavity, and the voice becomes flat and toneless. The speech too of the child suffers—M becomes B and N becomes D, &c. Bad respiration causes deficient aëration of the blood, and the little ones flag at their work, complain of headache, and cannot give attention in the class.

Where nasal breathing is badly interfered with, another sign is often present. The child cannot blow his nose, and the mucus tends to trickle from it and rest on his upper lip. This adds untidiness to apparent stupidity, and the bright smart face of the young learner is lost for the dull, sullen, almost revolting face of the mouth-breather. Such is the mouth-breather of the elementary schools, and, taken along with the subject of running ears, he is the commonest example of the so-called stupid child which the elementary school affords. I do not except the subject of defective sight. There is more

backwardness due to defective hearing than to defective sight, and when we consider the effects of early and thorough treatment of the deafness, a larger number of cases can be cured amongst the deaf than amongst the children with defective sight.

The number of school children who suffer from adenoids is very great. By suffering, I do not mean from deafness only, but from poor general health, from dull mentality, and from many other effects. Amongst the deaf and dumb—who are, however, hardly a fair standard—at least 30 per cent suffer so badly that removal is desirable. From the elementary schools of Glasgow we have not so far as I know any very extensive or reliable statistics.

In Sweden, in 1905, amongst 3,495 children examined, 450, or 13·8 per cent, showed well-marked adenoids, and 7·8 suffered from defective hearing. Another Swedish return shows that amongst 1,250 Board School children, 16 per cent were affected with adenoids. In Glasgow, large numbers are operated on both in the hospital and in private practice, and there is no reason to believe that the existing medical arrangements are unfit to cope with the cases which may come up for treatment under any system of the medical inspection of schools which may be instituted. At present from 2,000 to 2,500 cases of post-nasal adenoids are operated on annually in the hospitals of Glasgow. Probably another 1,000 are operated on in private practice. Even were the cases doubled—and were they doubled I believe all suitable cases would be operated on—the hospitals as at present constituted are quite capable of undertaking the work.

Now the aspect of this question which I wish to emphasise to-night is that the timely removal of post-nasal adenoids is nearly always followed by the recovery of hearing. There is no surgical procedure with which I am acquainted which is so uniformly followed by a good result, and the improvement is not confined to the hearing of the child, but extends to his general health and mental state.

The only test of any practical value in the school child is the human voice, and the most uniform method of applying the test is by whispered speech. Watches, acoumeters, and tuning-forks are of scientific and diagnostic value, *but the school child's progress depends on his being able to make out the speech of his teacher, hence speech is the test the latter must apply.*

Whispered speech is strictly not voice at all, because it is not vocal; it is only the upward current of air modified into

speech by the tongue and lips, but it is more uniform in pitch and intensity than vocalised speech. Still the speech test is not complete unless speech as used in conversation be also used as a test, for it is a curious fact, which, however, admits of an easy acoustical explanation, that hearing for whispered and vocalised speech do not vary in the same ratio. Taking whispered speech as the best test for a child's hearing, the whispering should take place at the end of an expiration, and the test should consist of two or three unconnected numbers or words pronounced consecutively such as 1, 9, 8; 3, 2, 7, &c., or twenty-one, twenty-eight, or Monday, Robert, yearly. In applying such a test several precautions are necessary:—

- (1) The ears should be tested separately, an assistant closing the ear not being tested by the moistened fore-finger pushed well into the meatus or outer end of the canal of the ear.
- (2) The speaker must be at the side of the child to be tested, whilst the latter should be directed to look straight ahead of him and not at the mouth of the speaker. Unless this precaution be taken the child will read the lips of the speaker.
- (3) The room in which the test is being made should be as quiet as possible, and should be not less than 20 feet long. It is better to be 30 feet long.

The average hearing distance for whispered speech in a noiseless room is about 25 yards, and when I tell you that a child who hears whispered speech at 5 yards is not likely to be backward on account of deafness, you will see how great the margin of "spare hearing" for the school child is. Any further diminution of this hearing power strains the attention of the child, and makes it advisable to put him in the front seat of the class, or into a small class where he may receive better individual attention. I do not mean to say that the hard-of-hearing child loses nothing by having his hearing distance for whispered speech reduced from 25 to 5 yards. Many of the finer communications both in the world of nature and in the household are lost to him, but the raised voice of the teacher as used in the larger classes of the elementary school is heard by such a hard-of-hearing child and little of what the teacher says is lost.

I do not think it possible to fix a hearing distance, the further reduction of which certainly causes backwardness in the school child; and if such a standard should ever be set up, I hope it will be done by the teacher and the school doctor and not by the doctor alone. A smart child with good eyesight and some practice in lip-reading will do well in a class, when a dull child with poor eyesight and the same

degree of deafness will become backward. Then a child with good language will fill in the context of a sentence only part of which he has heard, when a bad language scholar, or a younger child, will fail and become backward. But it should always be remembered that a deaf child who has to use his eyes to supplement his hearing in the work of an elementary school is straining his attention and looking up from his copybook or his drawing-board in case he should miss something said by the teacher. The work of the elementary schoolroom is arranged on the basis that lip-reading will not be required.

Children who hear whispered speech at 5 yards but not more may be called slightly hard of hearing. Those who only hear at 1 to 3 yards are moderately hard of hearing, and many of them become backward in school because of their deafness. The proper treatment for the "moderately hard" class is smaller classes and slow distinct speech on the part of the teacher, and if the child can be taught to lip-read it will be a great gain not only in school but during his whole life. Under a hearing distance of 1 yard the child may be classed as semi-deaf, removed from the ordinary school altogether, and taught by an articulation teacher in a small class of ten or twelve children. A child as deaf as this has very often defective speech; if the deafness has come on very early in life he almost always has poor speech.

Tested in this way, then, the deaf children of the elementary schools will fall into three classes:—

1. The hard of hearing, who require no alteration in methods of education, but who will only make satisfactory progress if put into smaller classes.

2. The semi-deaf, whose degree of deafness is so great that no perseverance in acoustic training will suffice for teaching. In these cases the eye must be called in to help the ear in the discerning of the spoken elements, and the muscles of articulation must be trained by a teacher specially equipped for this work. Such is articulation training, and such are the semi-deaf who hitherto have been sent to the institutions for the deaf and dumb, with whom they should never mix, and whose processes of thought are essentially different from theirs. *The semi-deaf should continue in the home and attend a day school.*

3. There is another class of children who have also been too long associated with the deaf and dumb, and who come under the notice of the teachers of the elementary schools. I mean the semi-mute child. This child has no hearing, as a rule, but

having lost his hearing at 5, 6, or 7 years, he will become dumb unless his speech be specially exercised. Like the semi-deaf child, his thought processes are more closely allied to those of the hearing than to those of the deaf-mute child, and he should be taught along with the semi-deaf child and should never associate with the deaf and dumb. These children have been brought more prominently before us of late years by an epidemic of the so-called "spotted fever;" but it should be remembered that meningitis has always been with us, although not in epidemic form, that it has always produced semi-mute children who have been sent to the institutions for want of a better provision, and that it will not disappear on the subsidence of the epidemic. *Like the semi-deaf child the semi-mute should continue in the home and attend a day school.*

HEARING FOR WHISPERED SPEECH IN CHILDREN OF THE ELEMENTARY SCHOOLS.

Normal Child,
25 yards.

Slightly hard
of hearing Child,
5 yards.

Semi-deaf Child,
1 yard.

Semi-mute Child,
o

In conclusion, I appeal to you as teachers of school children to look for these cases of partial deafness in your classes. They exist in every school in Glasgow. Wherever a boy is good at his games and poor at his class—"a dunce at syntax and a dab at taw"—test his hearing. When a child sits with a listless face and lets his attention flag, suspect post-nasal adenoids and test his hearing. The routine testing of hearing need never become the work of the school doctor. It is

properly the work of the teacher, and there are two inducements I hold out to you if you will undertake this work ; the one is transient, the other permanent. The transient one is that nowhere in this country has this work been thoroughly done on an extensive scale, so that if you in Glasgow care to take it up you will be doing original work. The second and permanent inducement is this, that whenever you detect deafness in a school child, if you will alter your methods to suit the needs of the child you will get progress such as you have not conceived possible. The semi-deaf and the semi-mute are not mentally defective children ; everyone of them, if properly handled, may be made a useful and self-supporting citizen. But let me beg of you to make the discovery of the deafness early in the school life of the child, and not, say, at 12 years of age, when the school period is nearly over and the brain is becoming less plastic for the acquisition of language. And do not be afraid of the time such testing will take. The teachers of Glasgow may unaided test every school child in the elementary schools in a single day of five or six hours.

